# Inflationary Expectations vs. Actual Inflation: A Reality Check for Turkey<sup>1</sup>

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### ABSTRACT

Central bank communication has gained importance after the last global financial crisis. Because the success of the monetary policy is highly dependent to management of expectations; the importance of the data obtained from expectation surveys has risen, as never before. The changes in expectations are so crucial on monetary policy decisions of the central banks whose primary aim is the price stability, like Central Bank of the Republic of Turkey (CBRT). Although, the effects of the inflation are better known by householders; most of the expectation surveys are reflecting the predictions of the market experts. So, this paper examines whether the inflation expectations of the householders are consistent with the actual inflation in Turkey. In order to find that, we use the data from CNBC-e's monthly inflation expectation survey which shows the expectations of the householders and Consumer Price Index which is announced officially by Turkish Statistical Institute. Because expectation surveys give qualitative data, we use the Carlson-Parkin method which is one of the most well-known probability method that quantifies the qualitative survey data. Moreover, we check the causal relationships between the actual and expected inflation by using the Geweke's Measure of Linear Feedback, Frequency Domain Causality and Wavelet Comovement methods. We expect to find out that to what extent the CBRT takes into account of householders' expectations on its policy decisions.

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**Keywords:** Monetary Policy, Inflation Expectations, Survey Data, Quantification Methods, Carlson-Parkin Method, Geweke's Measure Of Linear Feedback, Frequency Domain Causality, Wavelet Comovement

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### 1. Introduction

Central banks have become more important actors after the last global financial crisis in whole world. In order to avoid or overcome the crisis' bad effects, many central banks have implemented complex monetary policies. This condition has increased the importance of transparency of monetary policies.

Federal Reserve (Fed) and many other central banks have implemented expansionary monetary policy after the last global financial crisis. Their main purpose is eliminating the negative effects of the crisis. Almost all of them have tried to increase inflation and decrease unemployment in order to accelerate growth. Although the excess of liquidity which has been never seen in history, the inflation still seems weak. This situation leads to an important discussion, whether there will be a dramatic increase in inflation level in the future because of the liquidity excess.

Inflation is one of the most important economic indicator for a country. That's why, several number of central banks' primary aim is the price stability, like Central Bank of the Republic of Turkey (CBRT). The price stability is primary objective for central banks which conduct inflation-targeting regime. In economic theory, the more increase in money supply means the more increase in inflation level. But, this theoretical mechanism hasn't functioned properly during the last global financial crisis period.

Turkey is a country which faced very high level of inflation (upper than %100) in history. After the 2001 crisis, CBRT implemented implicit inflation-targeting regime from 2002 to 2005. Since 2006, CBRT has been implemented direct inflation targeting. In this respect, inflation expectations, which are obtained from some economic tendency or expectation surveys, have started to play more important role in Turkey. Unlike the developed countries; inflation is still continued to stay at high levels in recent times.

As we mentioned above, the success of monetary policies is highly dependent to more sufficient and improved central bank communication. In other words, central banks have to manage the expectations of the householders and take into account the changes in their expectations. As a result of that, the importance of the data obtained from expectation surveys has risen, as never before.

The changes in the price levels directly affect the householders' income level and their consumption decisions. So, the effects of the inflation are better known by householders who

have faced high level of inflation before like Turkish householders. In spite of this reality, most of the expectation surveys are reflecting the predictions of the market experts, not the householders. We believe that the householders' who are exposed to results of the changes in price levels could be a better address to track the inflation expectations. So, this paper examines whether the inflation expectations of the householders are consistent with the actual inflation in Turkey. In addition to that, we expect to find out that to what extent the CBRT takes into account of householders' expectations on its policy decisions and whether there are causal relationships between the actual and expected inflation

The study is composed of six sections: First, the aims of the study and an general overview are presented in the introduction part. The second section of this paper includes a brief literature survey on CPI index and inflation expectations. Section three explains the data of our analysis. In section four, we introduce the methodologies used in our calculations. Then, the quantified expectations are given in the fifth section. Finally, the conclusion part gives the results and inferences.

#### 2. Literature Survey

Future inflation rates are very important for the economy. And our expectation about future inflation affects both policymakers' decisions and economic agents' production and consumption decisions. Therefore it is essential to form these expectations accurately.

There are different methods of forecasting future inflation. Some of them are Inflation-Indexed Government Bonds, Inflation Swaps and Surveys. Each method have their advantages and disadvantages. Since we are focusing on accuracy of data obtained by surveys on this paper, we pass on the first two methods.

There are different views about the accuracy of surveys. Economic knowledge of subjects of a survey may differ a lot. And asking a person who doesn't know the current inflation rate about his/her expectation of future inflation rate(in number) doesn't seem to be logical. There is also the view that inflation expectations depending highly on previous month's inflation rate so that it is not independent therefore surveys are not an efficient tool to forecast future inflation.

There are also some ways to overcome these obstacles. Test subjects may consist of people whose economic knowledge is similar (economists only, for example) and instead of asking for specific numbers, it can be asked like "do you expect inflation to rise or fall?" and the

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collected qualitative data can be converted into quantitative data by methods like Carlson-Parkin.

There is no proven best way to forecast future inflation. The best method may be to consider all methods. In this paper we use CNBC-e inflation expectation survey data and see if it is consistent with the actual inflation rates. We use Carlson-Parkin method to convert qualitative data into quantitative data.

# 3. Data

Our data includes monthly CPI and Inflation Expectation Index of Turkey in order to test the relationship between expectation and real values. CPI is obtained from TurkStat (Turkish Statistical Institute) and Inflation Expectation Survey is obtained from CNBC-e Inflation Expectation Index. We use data from CNBC-e's inflation expectation survey, because it focuses on inflation expectations directly.

The latest officially published inflation rate belongs to April 2015. Depending on the availability of data, time period ranges from 2010:08 to 2015:04. The variables and descriptions are given on Table 1 and the number of participants of CNBC-e Inflation Expectations Survey on Table 2 in Appendix.

The question of the survey is that:

"Do you think the prices in Turkey will increase, decrease or stay about the same over next 12 months?

- 1. Increase
- 2. Decrease
- 3. Stay about the same
- 4. No idea"

We prefer to get the rate of respondents, not the number of them; because the number of participants could change month by month. This means each month is weighed equally. For example, both a month's results which has 716 participants and results of another month which has 720 participants have same weight for us.

$$PES + OPT + S + N = 1.0$$

where;

- PES, percentage of "increase" responds
- OPT, percentage of "decrease" responds
- S, percentage of "same" responds
- N, percentage of "no idea" responds

Then, we calculated monthly change rate of the inflation, CPI, according to the same month of one year ago in order to avoid from seasonal effects:

$$CPI_t = (CPI_t - CPI_{t-12})/CPI_{t-12}$$

We use the same method on expected results (CNBC-e Inflation Survey) in order to make a healthy compare because of the same reason. So, the number of observation decreased to 45 after this transformation. In other words, we could compare the time period between 2011:08 and 2015:04.

Jarque-Bera test statistic is used in order to check the variables normality. The calculated values are compared with chi-square test statistic, 7.81 (%95 confidence interval, 3 degrees of freedom). After that comparison, we find out that the series of PES and S are normally distributed; OPT is very close to the normal distribution and the N is leptokurtic and negatively skewed. This condition would lead to high prediction error. The detailed information about variables are summarized on Table 3 in Appendix.

We should mention that the ratio of the "stay about the same" and "increase" answers are very high for whole time period. On the average, 49.3 % of the answers is "increase", % 31.2 of them is "stay about to same", 10.9 % is "no idea" and 8.6 % is "decrease" in the 45-month period. According to us, to have a "no idea" option at the survey would increase the efficiency of the data. Otherwise, we believe that, most of the people had been given the "stay about the same" answer. This problem has been occurred most of the surveys that have not "no idea" option. On the other hand, we could say that the high levels of the actual inflation during that 45-month period make people more pessimistic about the future in terms of inflation. The lowness of the "decrease" answers' ratio confirms this. We should also recall that we could use limited observation, so our findings should be assessed in the light of this information.

4. Methodology

# 4.1 Quantifying Survey Expectations

### The Carlson-Parkin Method

Inflation expectations have a great importance in today's modern macroeconomic theory. These expectations are obtained from some economic tendency or expectation surveys. These obtained data from surveys are qualitative. Because, attendants' responds indicate whether inflation will increase, decrease, remain unchanged for next period or periods. The data gathered from these surveys do not have a mean value because they are qualitative (Oral, 2013). But we need to transform these qualitative data into quantitative data in order to use the data as an indicator for CPI prediction. In this study, we use Carlson-Parkin method (CP) with the aim of quantifying survey data on inflation expectations.

The probability method which is well known as Carlson-Parkin method (Carlson and Parkin, 1975) was first employed by Theil (1952). The original method has been derived for a trichotomous survey, i.e. the survey participants have three possible answer categories. In this context, the price expectations having three categories such as 'price will increase', 'price will decrease' and 'no change in price' (Batchelor and Orr, 1988) are used. But, in CNBC-e inflation expectation survey, the expectations having four categories such as "price will increase", "price will increase", "price will decrease", "no change in price" and "no idea" are used. Therefore, we will adapt the method to 4-responds case.

Here are some assumptions of the CP method;

- Attendants at time t (month) have formed an expectation  $\pi^{e}_{t+1}$  about inflation in the t+1 month when answering the survey.
- The individual subjective probability distributions can be aggregated to give the joint probability distribution  $f(x_{t+1}| \Omega_t)$ , where  $x_{t+1}$  is the future percentage change of prices at time t for the period t + 1 and  $\Omega_t$  the information set at time t.
- It is assumed that this distribution has finite first and second order moments and that  $E[x_{t+1}| \Omega_t] = \pi e_{t+1}^{e}$ , where  $\pi e_{t+1}^{e}$  is the expected value of x at time t for the period t+1.
- There exists an interval  $(\delta_t^{-L}, \delta_t^{U})$  around 0, with  $\delta_t^{L}, \delta_t^{U} > 0$ , such that the participants report 'no change' in prices if the price change expected by them lies within this interval.

The participants answer therefore in the following manner:

Prices will fall, if  $x_{t+1} \leq -\delta_t^{-L}$ stay about the same, if  $-\delta_t^{-L} < x_{t+1} \leq \delta_t^{U}$ Prices will increase, if  $\delta_t^{U} \leq x_{t+1}$ 

The proportions of the total response, denoted as  $_tOPT_{t+1}$  "opt",  $_tS_{t+1}$  "s",  $_tPES_{t+1}$  "pes" are written in terms of the aggregated probability distribution as

$$P(x_{t+1} \le -\delta_t^L) = \int_{-\infty}^{-\delta_t^L} f(x_{t+1}) dx_{t+1} = F(-\delta_t^L) = {}_t OPT_{t+1}$$

$$P(-\delta_t^L \le x_{t+1} \le \delta_t^U) = \int_{-\delta_t^L}^{\delta_t^U} f(x_{t+1}) dx_{t+1} = F(\delta_t^U) - F(-\delta_t^L) = {}_t S_{t+1}$$

$$P(\delta_t^U \le x_{t+1}) = \int_{\delta_t^U}^{+\infty} f(x_{t+1}) dx_{t+1} = F(\delta_t^U) = {}_t PES_{t+1}$$

A standardized variable is used with a specified distribution function. It is assumed that the indifference intervals are symmetric, i.e.  $\delta_t^{-L} = \delta_t^U = \delta_t$ . However, time-variation is allowed for the intervals. The equations above give solution to the unknown parameters:

$$\pi_{t+1}^{e} = \pi_{t}^{p} (_{t} opt_{t+1} + _{t}s_{t+1}) _{t}q_{t+1}$$
$$\sigma_{t+1} = -\pi_{t}^{p} 2 _{t}q_{t+1}$$
$$\delta_{t} = \pi_{t}^{p} (_{t} opt_{t+1} - _{t}s_{t+1}) _{t}q_{t+1}$$

where  $_{t}q_{t+1}^{-1} = _{t}opt_{t+1} + _{t}s_{t+1} - _{t}pes_{t+1} - _{t}n_{t+1}$ . The parameters depend on the choice of the distribution and the perceived inflation rate,  $\pi_{t}^{p}$ . The distribution function can be chosen as Normal (Carlson and Parkin, 1975). In some conditions, the normal distribution may not be convenient for the inflation expectations. To capture the deviation from normality; logistic, uniform, central-t which are more peaked than the normal distribution and chi-square distribution which is positively skewed are employed (Nielsen, 2003).

Berk (1999), who had applied central and non-central t distributions to Holland's consumer survey results in order to measure the inflation expectation, found that while the peakedness has a little importance on the expected inflation results; asymmetry has a great importance on that. Uniform and logistic distributions are also used often to transform qualitative data to quantitative data except normal distribution. But, those results are very close to the results which are calculated with normal distribution. In a different word; we will use the normal distribution in this study; because there is no evidence such that using normal distribution for quantifying the survey data is invalid (Yıldırım, 2002).

#### 4.2 Causal Relationships

#### Geweke's measure of linear feedback (Geweke, 1982)

Geweke's linear measure of feedback from one variable to another at a given frequency can provide detailed information about feedback relationships between growth and consumer confidence over different frequency bands. Even though frequency decompositions are generally investigated for neurophysiologic studies, it is important to address how the causality changes with frequency. This measure would enable us to quantify what fraction of total power at frequency  $\omega$  of variable x is attributed to variable y.

#### Frequency Domain Causality Analysis by Breitung and Candelon (2006)

By using a Fourier transformation to VAR (p) model for x and y series, the Geweke's measure of linear feedback from y to x at frequency  $\omega$  is defined as<sup>4</sup>:

$$M_{y \to x}(\omega) = \log \left[ \frac{2\pi f_x(\omega)}{\left| \psi_{11}(e^{-i\omega}) \right|^2} \right] = \log \left| 1 + \frac{\left| \psi_{12}(e^{-i\omega}) \right|^2}{\left| \psi_{11}(e^{-i\omega}) \right|^2} \right|$$
(1)

If  $|\psi_{12}(e^{-i\omega})|^2 = 0$ , then the Geweke's measure will be zero, then y will not Granger cause x at frequency  $\omega$ . Breitung and Candelon (2006) present this test by reformulating the relationship between x and y in VAR equation:

$$x_{t} = \alpha_{1}x_{t-1} + \dots + \alpha_{p}x_{t-p} + \beta_{1}y_{t-1} + \dots + \beta_{p}y_{t-p} + \varepsilon_{1t}$$
(2)

The null hypothesis tested by Geweke,  $M_{y \to x}(\omega) = 0$ , corresponds to the null hypothesis of  $H_0: R(\omega)\beta = 0$  where  $\beta$  is the vector of the coefficients of y and  $R(\omega) = \begin{bmatrix} \cos(\omega)\cos(2\omega)....\cos(p\omega) \\ \sin(\omega)\sin(2\omega)....\sin(p\omega) \end{bmatrix}$ .

<sup>&</sup>lt;sup>4</sup> For details of the computation of the measure, see Geweke (1982) and Breitung and Candelon (2006).

Breitung and Candelon (2006) simplify the Geweke's null hypothesis so that a usual F-statistics can be used to test causality in frequency domain.

#### Wavelet Comovement (Rua, 2010)

Moreover, we also use the wavelet comovement analysis in frequency domain developed by Rua (2010) which is shown to be superior to all the other comovement analysis.<sup>5</sup> The importance of wavelet comovement technique lies in the fact that it brings together the time dimension analysis and frequency dimension. Hence, comevement is observed through wavelets which form in frequency over a specified time interval. The only setback is there is not a test which measures the significances of the correlation coefficients obtained in the analysis. However, we assume that any coefficient over 0.75 denotes statistical significance.

#### 5. Quantified Expectations

The expected inflation question of CNBC-e's Inflation Expectations Survey is quantified in order to get quantitative inflation expectations of the consumers. The methods described above are used to obtain the quantified expectations series.

The probability method is employed to the inflation expectations gathered from CNBC-e Inflation Expectation Survey by using normal distribution function. Normal distribution is used in many studies since it is easy to handle (Oral, 2013). The running mean of inflation, from the beginning of the sample to the point where expectations are surveyed, is applied for scaling the parameter. The forecasting performance of the model can be seen on Table 4 in Appendix.

Figure 1 in Appendix illustrates the quantified expectations by Carlson-Parkin Method which derived via normal distribution. According to the graph, there is a consistency between expected and realized values in terms of trend and their directions. The survey responses generally give right direction about official values. So, we could say that CNBC-e Inflation Expectation Survey is a good indicator for CPI. But, there can be seen some gaps and spikes. The cause of the gap could be that the non-normality of "no idea" answers and the basket people have in mind compared to what the CPI is tracking. While making their forecasts, consumers can think about their own baskets such as food or energy prices rather than

<sup>&</sup>lt;sup>5</sup> Here, we do not explain the details of wavelet comovement methodology to save space. One should refer to Rua (2010) for specifics.

consumer prices (Oral, 2013). When we take a look at the timings of the spikes, we find out that these spikes generally occurred at the dates of critical monetary policy movements or the critical events such as the occurrence the high volatility of the value of Turkish Lira, strong declines of the oil prices, sharply increase of the interest rate by CBRT, etc. So, we could say that householders change their expectations rapidly and severely in the short term to the critical information has occurred. But, this information is digested by them in the medium and long terms. Thus, we could say that the householders form their expectations in a myopic view. In a different approach; we could also say that the CBRT tracks the change in the expectations of the householders closely and adapts its policy decisions in the light of these changes.

The Geweke linear feedback analysis results in Figure 2 show that the percentage of variance of actual inflation (CBRT) explained by the CNBC-e expected inflation measure (CNBCE) has varying degrees at different maturities. In the short-run, which is the high frequency part, the explained percentage is about 2,5. On the other hand, in the long-run, which is the low frequency part (close to the y-axis), the percentage explained increases to around 4. In the medium term, we also observe fluctuations between these two levels. This leads us to believe that expectations are fully incorporated into the information sets of Turkish households in a longer period.

The frequency domain analysis results in Figure 3 is clearly the most important finding in our paper. At almost all frequencies, the expected inflation causes actual inflation. But this result is especially very significant in the long-term and medium term. Given that, our period is between 2011 and 2015, this shows the important stance of inflation targeting that the Central Bank has implemented and the response of households to the policy maker. Moreover, the actual inflation also causes expected inflation significantly in the long-run, lending further support to a credible monetary policy build on the premises of explicit inflation targeting which can only be implemented by an independent and accountable Central Bank in an emerging economy like Turkey.

Finally, the empirical findings from the wavelet comovement analysis in Figure 4 signal the existence of wavelet comovement between actual and expected inflation at medium and long term frequencies. Moreover, we observe a strong correlation for 6 months between the two measures around 2011 August – 2012 January and 2014 August – 2015 April. These periods are characterized by lower fluctuations with significant comovement. This is probably due to

the resiliance of the Central Bank of Republic of Turkey to various demands from the speculative investors and other sources which favored diverging from the inflation targeting. Nonetheless, the unconventional policy mix of the Central Bank seems to bring together the actual and expected inflation closer than ever. This probably is the main reason why the economy has experienced lower rates of growth than historical average but better than many of the similar group of countries around the world. So, even lower rates of growth for a country with export orientation mainly dependent on imports and imports depending on financial capital inflow could have been the case if the Central Bank has not followed the policy mix in the 2011-2015 period. This is why the price stability has been so crucial for a country like Turkey and the expected and actual inflation have followed similar paths.

#### 6. Conclusion

In recent years, the management of expectations gained a serious importance. The last global financial crisis played a critical role on this situation, too. Central Banks have become more important actors due to the fact that most of them have implemented complex monetary policies in order to avoid from or overcome the crisis. People do not want to face any uncertainty under the inflation-targeting regime. So, transparency of monetary policies importance is increased. As a natural result of this process; the success of monetary policies depends on a forward-looking perspective. Management of expectations has become crucial inevitably. So, inflation expectation surveys are very critical for constituting an optimal monetary policy to obtain the achievement of price stability.

This paper has attempted to analyze the qualitative inflation expectations gathered from the survey data. The qualitative survey results are quantified by using Carlson-Parkin method. This method's performance is checked by using several statistical criteria, like mean square error, mean absolute error and Theil's inequality coefficient. Carlson-Parkin method is applied for the 4-respond survey question. In this approach, one advantage is that the scaling parameter is not estimated by imposing unbiased expectations. Another advantage is that the thresholds are permitted to vary over time (Oral, 2013). Moreover, we analyzed the causal relationship between the actual and expected inflation with some other methods such that Geweke Linear Feedback Analysis, Frequency Domain Analysis and Wavelet Comovement Analysis.

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We think there are some critical advantages of CNBC-e survey. One of them is that, it is formed by ordinary citizens who are in the market, not by market experts. The other one is that; this survey directly focuses on the inflation expectations while economic tendency surveys get this information indirectly. This difference probably decreases the error term and provides a more consistent relation in terms of CNBC-e survey. Another important advantage is that CNBC-e survey contains an respond option that "no idea". Because most of the economic tendency surveys do not have that option; most of the people who have no idea or hesitant accumulate on "Same" option. This led to tendency surveys' become less sensitive.

We find out that the CNBC-e Inflation Survey is a good indicator for the official values. The main trend of expected and realized values is consistent although there could occur some gaps and spikes from time to time. The cause of the gap could be that the non-normality of some series and the basket people has in mind compared to what the CPI is tracking. Timings of the spikes show us that the householders' expectations could change sharply in the short term when there is a critical flow of information. But, expectations are fully incorporated into the information sets of Turkish households in a longer period. In addition to that, the expected inflation causes actual inflation at almost all frequencies and also the actual inflation causes expected inflation significantly in the long-run. Moreover, we find the existence of wavelet comovement between actual and expected inflation at medium and long term frequencies.

Consequently, the unconventional policy mix of the Central Bank seems to bring together the actual and expected inflation closer than ever. Therefore, we can say that CBRT tracks closely the changes in expectations of the householders and conducts a successful policy in terms of management of the future expectations. Lending further support to a credible monetary policy build on the premises of explicit inflation targeting which can only be implemented by an independent and accountable Central Bank in an emerging economy like Turkey.

# 7. Appendix

### **Table 1: The Variables and Their Descriptions**

Variable Name	Description
PFS	Number of respondents who expects next month's CPI will be higher than current month /
ГĽб	Total number of attendants to CNBC-e Inflation Expectation Survey
ОРТ	Number of attendants who expects next month's CPI will be lower than current month /
UII	Total number of attendants to CNBC-e Inflation Expectation Survey
S	Number of attendants who expects next month's CPI will be at the same level with current
5	month / Total number of attendants to CNBC-e Inflation Expectation Survey
Ν	Number of attendants who has no idea about next month's CPI / Total number of
	attendants to CNBC-e Inflation Expectation Survey
СРІ	Consumer Price Index which is announced officially for the current month by TurkStat
	(seasonally adjusted)
CNDC	Expected Inflation Rate which is calculated for the next month from CNBC-e Inflation
UNBU	Expectation Survey

Table 2: Number o	of Observations	of CNBC-e	<b>Inflation</b> E	xpectation	Survey
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Period	Number of Observations	Period	Number of Observations	Period	Number of Observations
August 2010	720	March 2012	720	October 2013	720
September 2010	720	April 2012	720	November 2013	720
October 2010	720	May 2012	720	December 2013	719
November 2010	720	June 2012	720	January 2014	720
December 2010	716	July 2012	720	February 2014	720
January 2011	717	August 2012	720	March 2014	720
February 2011	720	September 2012	720	April 2014	720
March 2011	720	October 2012	720	May 2014	720
April 2011	720	November 2012	720	June 2014	720
May 2011	720	December 2012	720	July 2014	720
June 2011	720	January 2013	720	August 2014	720
July 2011	720	February 2013	720	September 2014	720
August 2011	720	March 2013	720	October 2014	720
September 2011	720	April 2013	720	November 2014	720
October 2011	720	May 2013	720	December 2014	720
November 2011	720	June 2013	719	January 2015	720
December 2011	720	July 2013	720	February 2015	720
January 2012	720	August 2013	720	March 2015	720
February 2012	720	September 2013	720	April 2015	720

 Table 3:Summary Information About Variables, 2011:08 – 2015:04 (45 months)

	CPI	PES	OPT	S	N
Mean	0.08	3.52	10.89	2.64	5.35
Maximum	0.11	5.08	15.54	3.95	6.95
Minimum	0.06	0.27	0.32	0.46	0.06
<b>Standard Deviation</b>	0.01	1.60	4.20	1.17	1.99
Skewness	0.20	-0.82	-0.72	-0.49	-1.64
Kurtosis	-0.54	-0.73	-0.61	-1.22	1.68
Jarque-Bera	6.30	8.26	7.51	9.31	6.23

Running Mean Of Inflation	MAE	MSE	TUI
Normal Distribution	0.0350	0.0020	3.6531

#### **Table 4: Information About Forecast Performance Summary Statistics**

It has been commonplace in the literature to compare different quantification methods on the basis of their forecasting performance (Smith and McAleer, 1995; Mankiw et al., 2003). Some standard forecast performance summary statistics consist of Mean Absolute Error (MAE) and Root Mean Square Error (RMSE). MAE is the measure that gives information on the average size of forecast errors; regardless of they are positive or negative. However, MAE has a weakness considering the viewpoint of a policy-maker using forecasts as a decision guide. If there are nonlinearities, one or two forecasts very far from the actual outcomes could be more damaging from a policy viewpoint than a larger number of forecasts not so far from the actual outcomes. RMSE, which squares errors before averaging them, is a measure that penalizes the forecaster who makes some large errors more heavily than the forecaster who makes mainly small errors (Bowles et al., 2007). In literature, researchers use these statistics in order to make the comparisons and to figure out the best quantification method even if the expectations are found not to be rational and have a backward-looking nature (Lyziak, 2003). In this study, we try to find out which method forecasts the actual inflation with the least error by means of these summary statistics. Then, the chosen method would be the best one for our analysis (Oral, 2013).

\* 
$$MAE = \sum_{i=1}^{n} |P_t - P_t^e| / n$$
 (mean absolute error of prediction)  
\*\*  $MSE = \sum_{i=1}^{n} (P_t - P_t^e)^2 / n$  (mean square error of prediction)  
\*\*\*  $TUI = \left[\sum_{i=1}^{n} (P_t - P_t^e)^2 / \sum_{i=1}^{n} (P_t)^2\right]^{1/2}$  (Theil's inequality coefficient)

where  $P_t$  and  $P_t^e$  denote actual inflation and inflation expectations respectively.



Figure 1: Quantified Expectations by Carlson Parkin Method

Figure 2: Geweke Linear Feedback Analysis







Figure 4: Wavelet Comovement Analysis



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